Running head: SCHEMA INCONSISTENCY AND CREATIVITY

Whether social schema violations help or hurt creativity depends on need for structure.

Małgorzata A. Gocłowska[1], Matthijs Baas[1], Richard J. Crisp[2], Carsten K. W. De Dreu[1]

[1]University of Amsterdam

[2]University of Sheffield

To appear in 2014 in *Personality and Social Psychology Bulletin.*

Access a corrected and copy-edited version of this article:

http://psp.sagepub.com/content/early/2014/04/29/0146167214533132.abstract

Word Count
Text, incl. abstract and references: 9,941/10,000
Abstract: 147/150

Authors Note

Corresponding author: Małgorzata A. Gocłowska, Department of Work and Organizational Psychology, University of Amsterdam, Weesperplein 4, 1018 XA Amsterdam, The Netherlands. Email: Goclowska.M@gmail.com. Author contribution: MAG and RJC designed Study 1. MAG, MB and CKWD designed Study 2. MAG analyzed data from both studies and wrote the paper. MB, RJC and CKWD provided critical revisions. Financial support was provided by a Marie-Curie postdoctoral fellowship awarded to MAG (299852; with CKWD).

Abstract

Although people and events that disconfirm observers' expectancies can increase their creativity, sometimes such social schema violations increase observers' rigidity of thought and undermine creative cognition. Here we examined whether individual differences in the extent to which people prefer structure and predictability, determine whether social schema violations facilitate or hamper creativity. Participants in Study 1 formed impressions of a schema-inconsistent female mechanic (vs. a schema-consistent male mechanic). Following schema-inconsistent rather than consistent information, participants low (high) in need for structure showed better (impeded) creative performance. Participants in Study 2 memorized a series of images in which individuals were placed on a schema-inconsistent (vs. consistent) background (e.g., an Eskimo on the desert vs. on a snowy landscape). Following schema-inconsistent imagery participants low (high) in need for structure increased (decreased) divergent thinking.

Keywords: social diversity, information processing, motivation, stereotypes, innovation

Creativity is essential to personal and professional success, and critical for tackling problems, fostering change, and innovation. Creative thinking allows people to produce life-saving technologies and medical applications, sustainable and environmentally friendly energy usage, and to manage economic downturn and promote economic prosperity. Psychologists agree that encouraging creativity and innovation is universally valued for individuals, groups and organizations (Amabile, 1983). But are there broader social conditions that promote creativity; and if there are, how can we understand individuals' psychological reaction to those conditions?

An intriguing development in this field suggests that creativity can be enhanced in response to environmental cues that are inconsistent with one's expectations (Maddux, Adam, & Galinsky, 2010; Ritter et al., 2012; Wan & Chiu, 2002). One of the key outcomes of the recent social and economic transformations in the Western world is that people become more and more mobile: they move countries, change professions, and challenge old power relations. In doing so, they increase the diversity and complexity of social structures (Crisp & Turner, 2011). For instance, we now more often see women become top politicians (e.g., Angela Merkel, the female chancellor of Germany), employees living and working outside their country of birth (e.g., British people retiring in Spain, Americans living in the Middle East), and traditionally "invisible" minorities embracing roles and positions that they had previously been barred from (e.g., Paralympics competitors). From a psychological point of view, instances like these violate people's schemata – generalized mental structures used to store information and make predictions about the world (Roese & Sherman, 2007).

Psychological research gives contradictory answers on whether experiences that are inconsistent with peoples' schemata hurt or help creativity. Some associate schema-inconsistencies with cognitive detriments (Mendes, Blascovich, Hunter, Lickel, & Jost, 2007), including reduced creativity (Porath & Erez, 2009). Others have found, however, that

schema-inconsistencies link to enhanced creativity (Gocłowska, Crisp, & Labuschagne, 2013; Miron-Spektor, Gino, & Argote, 2011; Ritter et al., 2012; Wan & Chiu, 2002). Here we investigate this seemingly paradoxical effect of schema-inconsistency on creative thought. We argue, and show, that being confronted with schema inconsistency decreases creativity when personal need for structure is high, yet stimulates creativity when need for structure is low.

Divergent Thought and Schema Inconsistencies

Creativity is defined as the production of ideas, problem solutions, and products that are novel and potentially useful (Amabile, 1983). Creativity capitalizes on – among other processes – divergent thought: flexible switching among a broad range of categories, approaches and sets (Nijstad, De Dreu, & Rietzschel, 2010). Creativity benefits from thinking "out of the box", and is restrained when individuals overly rely on their prior knowledge. When people generate ideas based on highly accessible stereotypes and schemata, they will produce ideas that are more similar to one another, and less often reach for remote, unusual associations. However, when individuals are compelled to reach beyond their schematic and stereotypic knowledge, this should boost their potential for divergent thinking and, subsequently, creativity (Förster, Friedman, Butterbach, & Sassenberg, 2005; Sassenberg & Moskowitz, 2005).

But reliance on schemata and stereotypes is not detrimental to all cognition – after all, schemata (abstract generalizations of information) allow individuals to create expectancies about the world around them, and swiftly regulate behavior according to those expectancies (Roese & Sherman, 2007). In consequence, consistency theories and social cognition research argue that schema- and stereotype-inconsistent information disrupts fluency in information processing (Rubin, Paolini, & Crisp, 2013), and can be experienced as threatening (Mendes et al., 2007). For instance, in one set of studies, interacting with a

schema inconsistent individual (the targets' accent or socio-economic status and ethnicity were inconsistent) led to cardiovascular threat responses, and poorer performance on a word finding task (Mendes et al., 2007). Likewise, witnessing unexpected violations of socially established norms decreased the total number of ideas, and the number of creative ideas generated (Porath & Erez, 2009).

In contrast to the above, schema-inconsistencies have also been found to up-lift creative performance. Evidence for this can be found in the intergroup and creativity literature. In one line of studies thinking up various counter-stereotypes led to the generation of more creative ideas (Gocłowska et al., 2013, Experiment 2), and more insight problems solved (Vasiljevic & Crisp, 2013 Experiment 3). In another series of experiments, creativity increased when individuals faced non-social schema inconsistencies. Wan and Chiu (2002) asked participants to solve a set of conceptual problems that were consistent (e.g., What is a piece of coat that is also a piece of animal skin?) or inconsistent with people's schemata (e.g., What is a piece of furniture that is also a kind of fruit?). Those primed with schema-inconsistent combinations performed better on the Torrance Tests of Creativity Thinking (Experiment 1), and built more creative LEGO models (Experiment 2).

Importantly, these effects were observed not just on creativity measures, but also on measures of divergent thinking, suggesting that it is specifically divergent thought – flexible switching among a broad range of categories, approaches and sets – that has led to improvements in creative performance. For instance in the studies of Ritter and colleagues (2012) participants who, in a virtual reality lab, were faced with events that were inconsistent (versus consistent) with their schemata about the laws of physics (e.g., participants walked towards a suitcase that was decreasing, instead of increasing, with distance), used more conceptual categories in idea generation (controlling for fluency). Also following exposure to

counter –stereotypes, participants' cognitive performance improved on a task where they had to overcome fixation on primed exemplars (Gocłowska & Crisp, 2013; Experiment 1).

Taken together, there is work indicating that schema inconsistencies are associated with detriments to cognitive performance, as well as work indicating schema-inconsistencies actually promote creativity and divergent thinking. Accordingly, we need to move away from asking *whether* schema inconsistencies hurt or help creativity, and seek to illuminate *when* either of these effects emerge.

Need for Structure and Idea Generation

While many research paradigms assume that inconsistencies are downright aversive, one can also imagine situations when having one's expectancies challenged is desirable: for instance when someone is bored, or motivated to achieve a more accurate view of a given topic (Kruglanski & Shteynberg, 2012). In other words, depending on the context, as well as individual dispositions, the extent to which individuals are open to disconfirmation will vary. One key facet of this type of readiness for schema-inconsistency is Personal Need for Structure: the extent to which individuals desire structure and predictability, and dislike uncertainty, oddity, and violation of expectations. (PNS; Rietzschel, De Dreu, & Nijstad, 2007; Neuberg & Newsom, 1993). People high in PNS tend to organize information using simple cognitive structures such as stereotypes (Neuberg & Newsom, 1993; Schaller, Boyd, Yohannes, & O'Brien, 1995), and when working on tasks, they prefer to do things according to fixed rules and procedures. Individuals high in PNS are more satisfied when given a task that contains, rather than lacks, structure (Slijkhuis, 2012, pp. 87–90). When given choice – for instance to draw an alien creature according to structured guidelines, or without them - individuals high in PNS more often choose to work with guidelines (Slijkhuis, 2012, pp. 84–86). Conditions permitting their preference for a more structured process occasionally translates into generating ideas in a convergent manner. This was discovered when Rietzschel

et al. (2007) measured PNS and Personal Fear of Invalidity (PFI, the concern about making the wrong decision). The authors argued that PNS could lead to the generation of many ideas within a narrow set of semantic categories. However, whether this actually happens, depends on PFI. In individuals high in PFI, who tend to doubt and deliberate, convergent idea generation will be undermined, because the tendency to deliberate (PFI) will interfere with generating ideas in a simple and decisive fashion (PNS). When PFI is low however, high PNS individuals will be free to generate ideas quickly and decisively, without unnecessary interruptions. In line with this hypothesis, in two experiments, a combination of high PNS and low fear of invalidity led participants to generate convergent ideas: numerous ideas within narrow sets of semantic categories (Rietzschel et al., 2007). Interestingly, increased convergent thought also led to the generation of more original ideas, highlighting convergent thought as a second mechanism – alongside divergent thinking – via which creative ideas can emerge (also see Dual Pathway to Creativity Model; De Dreu, Baas, & Nijstad, 2008; Nijstad et al., 2010).

Because people high in PNS have this high preference for structure, schematic thinking, and convergent idea generation, PNS might interfere with the divergent thinking style induced by schema-inconsistencies. This can perhaps be better understood when we consider how individuals reach creative solutions using either divergent or convergent thought. When asked to generate different uses of a brick, people can draw from a wide base of semantic categories: their ideas could have to do with building something, using the brick as a weight, or with using it for the purpose of violence. When generating ideas, a divergent thinker would quickly alternate between different categories (“use it to hit someone”, “build a wall”, “use as a doorstep”), while a convergent thinker would tend to focus on exploiting one and the same semantic category for an extended time (“to build a house”, “to build a wall”, “to build a kitchen cabinet”). So, while convergent thinkers look for ideas by digging deep,

divergent thinkers use a broad set of semantic categories, and tend to switch between these categories a lot. But what happens when both tendencies are active, such as in the case of high PNS individuals exposed to inconsistencies? One can imagine that when divergent thinking is activated in individuals high in PNS, their preference for convergent thought will interfere with the effects of the prime (De Dreu, Nijstad, & Baas, 2010).

Some indirect support for the idea that PNS moderates the effect of inconsistencies on creativity comes from studies showing that variables related to PNS moderate the impact of inconsistencies. For instance, in one study schema-inconsistencies (exposure to vignettes where a target's university grades were inconsistent with the target's performance) led to increased quality and originality of creative solutions, but only in individuals with high problem re-construction ability (akin to low PNS; Reiter-Palmon, Mumford, O'Connor Boes, & Runco, 1997). In another line of research, multicultural experiences - experiences which tend to violate people's expectations - led to increased divergent thought, but only in individuals who were high in openness to experience (akin to low PNS; Neuberg & Newsom, 1999), and in the absence of time pressure (akin to low PNS; Leung & Chiu, 2008). Also PNS itself has been found to inhibit the effects of stimuli that normally associate with creativity. In a series of studies, informational feedback, work autonomy, and decreased control – aspects of the work environment that are associated with more permissiveness and freedom to generate divergent solutions - increased creativity and innovation at work, but only in individuals whose PNS was low (Rietzschel, Slijkhuis, & Van Yperen, 2013; Slijkhuis, Rietzschel, & Van Yperen, 2013). Finally, in the realm of intergroup processes, prejudice reduction interventions that used counter-stereotypic impression formation tasks increased the flexibility and originality of ideas, but only when PNS was low (Gocłowska & Crisp, 2013).

The Current Studies: Hypotheses and Overview

Our review of the literature suggests that schema inconsistencies can both block and release creativity, and that PNS might be the key to understanding this paradox. In individuals high in PNS, their preference for structure and convergent thinking may disrupt divergent thinking processes prompted by inconsistencies, with reduced creativity as the end result. However, in individuals low in PNS, who have less of a preference for structure and convergence, schema inconsistencies should prompt more divergent and creative thought without any obstacle. We tested these possibilities in two studies, using the PNS Scale (Neuberg & Newsom, 1993; Rietzschel et al., 2007), and two different manipulations of schema-violation as the core independent variables. Accordingly, we predicted that schema violations would impede creativity in individuals higher in PNS, and promote creativity in those with lower PNS. In Study 1, we focused on creative insight performance; in Study 2 we considered convergent and divergent thinking as two core processes underlying creativity (e.g., Baas, De Dreu, & Nijstad, 2008). The use of both convergent and divergent processes in Study 2 allowed us also to test the prediction that schema inconsistencies (under varying levels of PNS) affect specifically divergent, and not convergent thinking.

Study 1

Participants

Sixty-nine undergraduates from a UK university completed an online questionnaire in exchange for course credit. We analysed data from 61 participants (*M* age = 21, 20% males, 57% psychology students). Because the study was run online, we excluded participants with extremely long or short completion times. This did not alter the focal results in any significant way[1].

Procedures and Manipulations

After providing informed consent, participants first completed the 12 item Personal Need for Structure scale (7 point Likert-type scale with $M = 4.13$, $SD = 0.93$, and Cronbach's

α = .84; Neuberg & Newsom, 1993) followed by filler personality items. The PNS scale contains items such as "I enjoy having a clear and structured mode of life." or "I don't like situations that are uncertain." To manipulate schema inconsistency, we presented participants with a stereotype consistent (male mechanic), or inconsistent (female mechanic) target, and asked them to describe this person using 10 single adjectives (following Gocłowska et al., 2013; Hutter & Crisp, 2005). Debriefing took place upon completion of the study.

Dependent Variables

Following the schema inconsistency manipulation participants responded on five questions about their creative self-efficacy (Tierney & Farmer, 2002; further ignored), and completed 15 items of the Remote Associates Test (RAT; Mednick, 1962). Participants' task was to find a word analogous to three other words. For instance the words *Salt, Deep, Foam* are associated with the answer *Sea*, and words like *Magic, Plush, Floor* with the word *Carpet.* When solving this creative performance task, participants usually think of objects close to one of the presented exemplars, but in order to find a correct solution, they have to overcome fixedness on immediate associates, and generate a remote association – only this type response will provide a well-fitting solution to the problem. Divergent, flexible thinking is needed to perform this task (Harkins, 2006).

Following the RAT, participants were asked to rate the manipulated target on five features: surprise, familiarity, ease, complexity and similarity of the two categories forming the schema-inconsistent (vs. consistent) combination (1-5 Likert-type scale; see Gocłowska & Crisp, 2013); after reverse-scoring the items formed one scale (Cronbach's α = .80). Participants also completed the Mayer and Gashke Brief Mood Introspection scale (1988). To examine its possible associations with PNS, and to explore whether schema violations alter mood states related to creativity (Baas et al., 2008), we computed a variable of positive activating moods (7-point Likert-type scale, *caring, peppy, lively, loving, happy, active*; α

=.73), negative activating moods (*jittery, nervous, gloomy, sad, fed up, grouchy*; α =.81), positive deactivating moods (*content, calm*; α =.68), and negative deactivating moods (*drowsy, tired;* α =.78).

Results

Analytic approach and manipulation check.

Data were analyzed using moderated regression analyses in the SPSS PROCESS macro (Hayes, 2013), with conditions being contrast coded as -1 (schema-consistent) and +1 (schema-inconsistent). The manipulation and the centered continuous PNS score were entered as independent variables. To check the adequacy of the schema inconsistencies manipulation, we entered surprise as the dependent variable. This produced a main effect of condition ($B = 0.42$, $t = 4.62$, $p < .001$), such that the schema inconsistent target ($M = 4.33$, $SD = .70$) elicited more surprise than the schema consistent one ($M = 3.49$, $SD = .75$). The effect of PNS ($B = -0.01$, $t = -0.05$, $p = .960$), and the interaction term ($B = 0.20$, $t = 1.90$, $p = .062$) were not significant.

Mood.

We ran the same regression analyses on each of the four mood variables. PNS predicted less positive activating moods ($B = -0.24$, $t = -2.08$, $p = .041$), and less positive deactivating moods ($B = -0.31$, $t = -2.01$, $p = .049$), but not negative activating ($B = 0.31$, $t = 1.92$, $p = .061$), nor negative deactivating moods ($B = -0.01$, $t = 0.47$, $p = .962$). There were no significant effects of inconsistency (all ps >.26), nor significant interaction effects (all ps > .16) on any of the mood states.

Creativity.

To test our main hypothesis, we repeated the above analysis, but this time entering the number of correctly solved RAT-items as the dependent measure of creativity. Analysis revealed no effect of PNS ($B = -0.61$, $t = -1.21$, $p = .233$), nor schema inconsistency ($B =$

0.06, $t = 0.14$, $p = .886$), but a significant two-way interaction between condition and PNS ($B = -1.37$, $t = -2.67$, $p = .010$; for effect sizes and power, see Methodological appendix). The interaction is shown in Figure 1 (left panel).

We inspected the slopes representing the relationship between PNS and RAT performance as a function of the manipulated variable. This revealed a significant negative effect of PNS on RAT performance in the schema inconsistency condition ($B = -2.03$, $t = -2.40$, $p = .020$). In the schema consistency condition there was a positive but insignificant effect of PNS on RAT performance ($B = .71$, $t = 1.22$, $p = .227$). A PNS score of 5.06 was equivalent to 1*SD* above the mean, and a PNS score of 3.21 indicated 1*SD* below the mean ($M = 4.13$, $SD = 0.93$). To understand at what levels of PNS inconsistencies impact creativity, we probed the interaction using the Johnson-Neyman regions of significance estimate, available via the SPSS PROCESS macro (Hayes, 2013)[2]. On the upper end of the scale (note that in this study we used a 1-7 scale), the regions of significance analysis identified 5.19 (equivalent to 1.14 *SD* above *M*) as the point of transition between a statistically significant, and a statistically non-significant effect of the manipulation ($B = -1.38$, $t = -2.00$, $p = .050$). This indicates that for PNS scores from 5.19 to the highest value observed (6.17), schema inconsistency significantly reduced creative performance. In other words, at higher levels of PNS, participants exposed to schema inconsistency were significantly less creative, than those exposed to a schema consistent target. However, Figure 2 also shows 3.24 (0.97 *SD* below *M*) as the point of transition at the lower end of the scale ($B = 1.29$, $t = 2.00$, $p = .050$). This indicates that for PNS scores from 3.24 to the lowest observed value (1.58), schema inconsistency positively predicted creative performance. In other words, at lower levels of PNS, participants exposed to schema inconsistency were significantly more creative, relative to those exposed to a schema consistent target. To eliminate the possibility that the effects obtained have been due to changes in mood, we repeated the same analyses but this time

including the four mood types as covariates in our analyses – the results remained unchanged[3].

This pattern of results supports our prediction that facing a schema inconsistent (vs. consistent) target elicits less creative insights when PNS is high, and more creative insights when PNS is low. These effects are specifically caused by the inconsistent stimuli. Finally, this study found no support for the possibility that the resulting uplift and decrease to creativity are due to mood.

Study 2

In Study 1 exposure to schema inconsistency decreased creative performance when PNS was high, yet increased creativity among those with low PNS. Creative performance was operationalized in terms of insight performance, which requires divergent thinking (Harkins, 2006; Kounios et al., 2006). Study 2 was designed to directly test the effect to divergent thinking, using a task that allows for independent assessment of convergent and divergent thinking processes (i.e., the "pasta task"; De Dreu, Baas et al., 2013; Dijksterhuis & Meurs, 2006). Testing effects of inconsistencies to both convergent and divergent thinking is something that, to our best knowledge, has not been done before and could further strengthen the claim of specificity of the schema-inconsistency effect. In addition, we created a new set of materials to manipulate schema violations, so as to exclude the possibility that Study 1 results are limited to the specific (counter) stereotypes of (fe)male mechanics.

Pretest

Study 2 manipulated schema inconsistency via visual stimuli: we asked participants to memorize a series of target photographs presented on a background that was matched, or mismatched with the target identity (e.g., an Eskimo walking on a snowy landscape vs. an Eskimo walking the desert). We initially created 20 images by placing a human target on a background that was consistent or inconsistent with expectations. The images in both

conditions were counter-balanced on content (i.e., the same targets and backgrounds were used in either condition). For instance in the inconsistent condition we placed a Bedouin on a snowy landscape, and an Eskimo on the desert, while in the consistent condition we reversed the combination by placing the Bedouin on the desert, and the Eskimo on the snowy landscape. We pretested 20 images built from 5 sets of background and target stimuli. Set 1 combined an astronaut/hipster on the Moon/beach, Set 2: an Eskimo/Bedouin on a snowy/desert background, Set 3: men in suits/Buddhists in an office/Buddhist temple, Set 4: an imam/priest in front of a mosque/church, Set 5: a footballer/hockey player on a soccer field/ice rink. To ensure that the images that we used in the two conditions differed maximally in terms of surprise, but minimally in terms of valence, 32 participants rated each of the 20 pictures on a series of adjectives measuring surprise (*funny, surprising, odd, strange, intriguing, deviant and familiar)*, ambivalence (*ambivalent)*, and valence (*positive, negative*). The surprise variable achieved Cronbach's $\alpha = .83$; ambivalence and the two valence items did not form a scale with the remaining items (valence Cronbach's $\alpha = .27$), and were subsequently used as single-item variables in the analysis. A series of 2 (inconsistency) x 2 (target) mixed-model ANOVAs revealed a significant difference for surprise between consistent and inconsistent images for all 5 sets: Fs (1,30) between 63.27 - 150.01, all p's < .001. In all cases, the inconsistent images were found more surprising than the consistent ones. There was also a significant difference for ambivalence between consistent and inconsistent images for all 5 sets: Fs (1,30) between 8.44 - 20.72, all p's < .01, such that, in all cases, the inconsistent images were found more ambivalent than the consistent ones.

We ran similar analyses with the items *negative* and *positive* as dependent variables, which only revealed differences in valence for the third set of images (men in suits/Buddhists; in an office/Buddhist temple). For this set, the two inconsistent images (M =

3.50, *SD* = 1.14) were seen as more negative than the two consistent ones (*M* = 2.73, *SD* = 1.06): *F* (1,30) = 22.81, *p* <.001; while *p*s > .12 for the remaining sets. Corresponding differences for Set 3 were found on the item *positive,* where the inconsistent images (*M* = 3.61, *SD* = 1.09) were seen as less positive than the consistent ones (*M* = 4.11, *SD* = 1.11): *F* (1,30) = 8.70, *p* =.006, while *p*s > .06 for the remaining sets. In addition to significant differences in valence, there was also an ambiguity about the identity of the targets depicted in Set 3 (men in black suits could be seen either as businessmen, or as Mafiosi), and for that reason, these images were not included in Study 2.

Participants

Eighty-five undergraduate students at the University of Amsterdam participated for payment (equivalent of 5 USD) or course credit. We analyzed data from 82 participants (*M* age = 23, 32% males, 32% psychology students). We dropped two participants whose questionnaire responses could not be matched with their results on the creativity task, and one participant who entered song lyrics, instead of performing the task. Removing those participants did not alter the focal results or conclusions.

Procedures and Manipulations

Participants first completed a Dutch version of the PNS scale (6-item Likert type scale, with *M* = 3.36, *SD* = 0.86, and Cronbach's α = .84; Rietzschel et al., 2007), followed by several other filler personality items. Thereafter, participants were shown a series of inconsistent (vs. consistent) images. Participants in the consistent condition saw an astronaut on the Moon, a hipster on the beach, an Eskimo on a snowy background, a Bedouin on the desert, an imam in front of a Mosque, a priest in front of a church, a footballer on a soccer field and, and a hockey player on an ice rink. In the inconsistent condition, participants saw an astronaut on the beach, a hipster on the Moon, an Eskimo on a desert, a Bedouin on a snowy landscape, an imam in front of a church, a priest in front of a Mosque, a footballer on

an ice rink and a hockey player on a football field (for examples of stimuli see Figure 2). To motivate participants to look at the images, each image displayed was paired with an unrelated word, and participants were told that later on in the procedure they would be tested on how well they have memorized the word-image pairing (to avoid deception, we included a recall test; interested readers may obtain results from the corresponding author)[4].

Dependent Variables

Following the image viewing task, participants were asked to complete the 'Pasta-task' - to come up with as many names for a new kind of pasta as they could think of, within three minutes (De Dreu et al., 2013; Dijksterhuis & Meurs, 2006; Marsh, Ward, & Landau, 1999). To rate fluency we counted the number of names generated by each participant. In the instruction of the task we embedded five examples of pasta names – all of them ending with the letter "i" (e.g., "maloveni", "paragoni"). If participants, when generating ideas, used more pasta names in line with the prime (ending with "i"; convergent items), this would indicate convergent thought, where a previously activated grammatical rule leads to the generation of items following that rule. If, on the other hand, participants used ideas not in line with the primed rule (not ending with "i"; divergent items) this would indicate an ability to overcome the recently activated solution, akin to overcoming "functional fixedness". Additionally, the task allowed us to count the number of times participants repeat the same rule in idea generation (repetitions), and the number of times they switch rules (switches) (Baas, De Dreu, & Nijstad, 2012; De Dreu et al., 2013). This measure allows to assess how easily individuals change between various approaches to a task – capturing another aspect of divergent (vs. convergent) thought. Because going beyond an activated rule is likely to lead to a greater variety of responses, we expected that divergent items would be highly correlated with switches, and convergent items with repetitions (De Dreu et al., 2013).

Using an Excel formula, we assigned each pasta name to one of two categories: those ending with an ‘‘i’’ (converging items, as they are in line with the cue given in the instructions) or those not ending with an “i” (diverging items). We also counted category repetitions (number of times in which participants consecutively generated pasta names with the same ending, e.g., lusagn<u>a</u>, pastat<u>a</u>, tomat<u>a</u>), and category switches (number of times when participants switched from one ending, e.g., pennin<u>i</u>, to another ending, e.g., lusagn<u>a</u>). Category repetitions[5] associated positively with convergent thinking, $r(81) = .83$, $p < .001$, and category switches associated positively with divergent thinking, $r(81) = .84$, $p < .001$. There were no significant correlations between divergent and convergent items, nor between repetitions and switches (all ps $< .171$, $|r| < .15$). This was expected, given that participants were not limited in the amount of items that they could generate. As a result, the number of any type of items was a function of the opposite item type, *and* of the total number of items generated (e.g., the number of divergent items was a function of convergent items *and* of the total number of ideas generated; also see Nijstad et al., 2010).

Following the pasta task participants performed a 14-item gap filling exercise (manipulation check of motivational orientation, also see Note 4; further ignored) and were ostensibly tested on their memory of the word-picture association: one by one, images from the manipulation task were displayed on the screen alongside eight words, and participants had to decide which of the eight words displayed originally appeared with the picture. Next, participants were asked to rate the previously seen images on 18 characteristics, related to how interesting (*interesting, captivating, noticeable, intriguing, stimulating, funny;* Cronbach’s $\alpha = .82$), surprising (*strange, odd, deviant, unfamiliar, indefinable,* reverse coded *personally relevant, familiar*; Cronbach’s $\alpha = .80$), and unpleasant (*unpleasant, negative, distasteful,* reverse coded *positive*; Cronbach’s $\alpha = .79$) they were, and a single item measuring ambivalence. They also responded to questions about their enjoyment of the pasta

task, and concentration during the procedure, and rated themselves on 29 mood adjectives (De Dreu et al., 2008). We computed four variables for different levels of hedonic tone and activation: positive activating moods (*upbeat, happy, excited, cheerful*, α = .71), negative activating moods (*fearful, angry, ashamed, anxious, contemptuous, upset, worried, loathing, guilty*; α= .89), positive deactivating moods (*calm, relaxed, at ease,* α = .73), and negative deactivating moods (*discouraged, apathetic, down, washed-out, depressed, tired, sad;* , α= .83; De Dreu et al., 2008). Six items did not contribute to the scales and were dropped from the analyses.

Results

Analytic approach and manipulation checks.

Data were analyzed using moderated regression analyses in the SPSS PROCESS macro, with mean centered manipulation and PNS entered as independent variables, and various image ratings entered as dependent variables. Images in the schema inconsistency condition elicited more surprise (M = 5.22, SD = .77 vs. M = 4.40, SD = 1.04; B = 0.42, t = 4.13 $p < .001$), and were perceived as more ambivalent (M = 4.73, SD = 1.03 vs. M = 3.73, SD = 1.43; B = 0.50, t = 3.60, p = .001), but not more interesting (M = 4.34, SD = .95 vs. M = 3.88, SD = 1.22; B =0.21, t = 1.80, p = .078), or (un)pleasant (M = 3.18, SD = .94 vs. M = 2.87, SD = 1.31; B = -0.13, t = -1.09, p = .279). In addition, people higher in PNS judged the images as more unpleasant (B =0.38, t = 2.67 p = .009), but there was no difference on the rating of interesting (B =-0.28, t = -1.98, p = .052), surprise (B = 0.13 , t = 1.08, p = .284) or ambivalence (B = -0.00 , t = 0.01, p = .994). Finally, there were no significant interaction effects on the variables measuring surprise (B = 0.19 , t = 1.59, p = .116), interest (B = 0.04 , t = 0.31, p = .754), unpleasantness (B = 0.15 , t = 1.01, p = .316), or ambivalence (B = -0.16 , t = -0.98, p = .330).

Mood.

Moderated multiple regression revealed, in line with Study 1, a negative association between PNS and positive activating moods (B = -0.22, t = -2.28, p = .025). PNS had no effect on positive deactivating moods (B = -0.18, t = -1.84, p = .070), negative activating moods (B = -0.09, t = 1.47, p = .150), or negative deactivating moods (B = 0.15, t = 1.92, p = .058). More importantly, there were no significant effects of inconsistency (all ps > .39), and no significant interaction effects, (all ps > .13) on any of the mood states.

Fluency and convergent thinking.

We tested the influence of schema inconsistency and PNS on fluency (number of generated ideas), convergent ideas, and category repetitions. Moderated multiple regression revealed no main effects on fluency (inconsistency B = -0.07, t = -0.07, p = .945; PNS B = 0.72, t = 0.59, p = .558) and no interaction effects (B = -1.20, t = -0.98, p = .328). There were also no main effects (inconsistency B = -0.12, t = -0.87, p = .389; PNS B = 0.15, t = 0.97, p = .335) and no interaction effect (B = 0.08, t = 0.49, p = .623) on convergent thinking, and no main effects (inconsistency B = 0.04, t = 0.28, p = .779; PNS B = 0.15, t = 1.01, p = .314) and no interaction effect (B = .10, t = 0.66, p = .514) on repetitions. Thus, fluency and convergent thinking did not depend on PNS, schema violations, or their interaction.

Divergent thinking.

Entering divergent thinking as the dependent variable revealed no significant main effects (inconsistency B = 0.06, t = 0.40, p = .688; PNS B = -0.17, t = -1.08, p = .283). However, the predicted interaction between PNS and inconsistency was significant, B = -0.51, t = -3.21, p = .002. As in Study 1, we inspected the slopes representing the relationship between PNS and divergent items as a function of the manipulated variable. This revealed a significant negative effect of PNS on divergent items in the schema inconsistency condition (B = -0.69, t = -2.90, p = .005). In the schema consistency condition PNS had a positive effect on divergent items, but the effect was not significant (B = 0.33, t = 1.58, p = .119). A PNS

score of 4.22 was equivalent to 1*SD* above the mean, and a PNS score of 2.51 indicated 1*SD* below the mean (M = 3.36, SD = 0.86). To understand at what levels of PNS inconsistencies impact creativity, we probed the interaction using the Johnson-Neyman regions of significance estimate. As can be seen in Figure 1 (middle panel), the regions of significance analysis identified 4.22 (1.00 *SD* above *M*) as the point of transition between a statistically significant, and a statistically insignificant effect of the manipulation (B = -.39, t = -1.99, p = .050). This indicates that for PNS scores from 4.22 to the highest value observed (5.42), schema inconsistency was negatively related to creativity. In other words, at higher PNS, participants exposed to schema-inconsistency were significantly less creative than those exposed to a schema consistent target. However, the analysis also revealed 2.85 (0.59 *SD* below *M*) as the second point of transition (B = .31, t = 1.99, p = .050). This indicates that for PNS scores from 2.85, to the lowest observed value (1.50), schema inconsistency was positively related to creativity. In other words, at lower PNS, participants exposed to schema-inconsistency were significantly more creative, relative to those exposed to a schema consistent target. Controlling for moods did not change our conclusions.[6]

Category switches.

The same analysis with conceptual switches entered as a DV revealed no significant main effects (inconsistency B = -0.13, t = -.23 p = .820; PNS B = -0.64, t = -.94, p = .351), but an interaction effect between PNS and inconsistency, B = -2.22, t = -3.23, p = .002. We inspected the slopes representing the relationship between PNS and divergent items as a function of the manipulated variable. This revealed a significant negative effect of PNS on divergent items in the schema inconsistency condition (B = -2.89, t = -2.82, p = .006). In the schema-consistency condition the effect of PNS was positive, but it did not reach significance (B = 1.55, t = 1.69, p = .094). Figure 1 (right panel) shows that the regions of significance analysis identified 3.94 (0.67 *SD* above *M*) as the point of transition between a statistically

significant, and a statistically insignificant effect of the manipulation, $B = 1.42$, $t = -1.99$, $p = .050$. This indicates that for PNS scores from 3.94 to the highest value observed (5.42), schema inconsistency was negatively related to creativity. In other words, at higher PNS, participants exposed to schema-inconsistency were significantly less creative, than those exposed to a schema consistent target. However, the analysis also revealed 2.60 (0.89 *SD* below *M*) as the second point of transition ($B = 1.56$, $t = 1.99$, $p = .050$). This indicates that for PNS scores from 2.60, to the lowest observed value (1.50), schema inconsistency was positively related to creativity. Controlling for moods did not alter our conclusions.[7]

In sum, similar to results in Study 1, facing schema-inconsistent targets elicited less divergent thinking when PNS was high, and more divergent thought when PNS was low. This supports our hypothesis that the benefits of inconsistent information to creativity are contingent upon PNS. In addition, we showed that these effects are specific to the generation of divergent ideas, and to peoples' ability to switch between categories, but not to convergent information processing or repetition of ideas from the same categories. As in Study 1, the current study found no support for the possibility that the resulting uplift and decrease to creativity are merely due to a change in mood states.

General Discussion

From Leonardo Da Vinci to Steve Jobs, artists and innovators are often described as "thinking differently" (Sassenberg & Moskowitz, 2005), or "defying the crowd" (Sternberg & Lubart, 2002). Indeed, scientific inquiry into creativity (Ritter et al., 2012; Wan & Chiu, 2002), management (Miron-Spektor et al., 2011), diversity (Crisp & Turner, 2011; Gocłowska et al., 2013), and culture (Leung & Chiu, 2010), all suggests that circumstances which allow people to learn that things are different from what was initially expected, can foster superior creativity and divergent thought. But things that are odd and novel also tend to disrupt how people think and perform tasks, and are disliked by some (e.g., Leicht, Crisp, &

Randsley de Moura, 2013; Mendes et al., 2007). In light of this, it is important to ask whether inconsistencies evoke creativity in everyone, or only some individuals. Here we argued, and showed, that having one's schemata and stereotypic expectations violated can trigger divergent processing and promote creative insight performance. This happens, however, only among those individuals who are low in PNS. Among individuals high in PNS, we observed the reverse – these individuals became less divergent and flexible, and achieved fewer creative insights when confronted with schema violating information.

Mechanisms and Questions for Future Research

The present studies reveal that for creativity to happen, in contexts characterized by schema-inconsistencies, PNS needs to be low. However, they also provide the stimulus for further discussion about what aspects of PNS are responsible for the observed effect. One possibility is that people high in PNS dislike schema-inconsistencies, and that this induces negative affect, which subsequently decreases divergent thinking and creativity. If this affect-based explanation were true, however, we should have observed more negative evaluations of stimuli, and perhaps also more negative moods, when high PNS individuals encountered inconsistencies. Instead, in the current studies the PNS – inconsistency interaction did not predict liking of the stimuli, nor participants' mood. Furthermore, controlling for mood as a covariate did not change the pattern of results in any significant way.

More likely is the process explanation described in the introduction. According to this rationale, high PNS individuals have a habitual preference for convergent thinking (and they do think convergently when fear of invalidity is low, see Rietzschel et al., 2007), and this preference interferes with divergent thinking prompted by schema-inconsistencies. Because convergent thinkers generate ideas by going deep, and divergent thinkers generate ideas by being broad and thinking flexibly, these two thinking styles, when used simultaneously, do not mix well. Especially the tendency to rely on rules, prototypes, and stereotypes in

thinking, that seems to be preferred by individuals high in PNS, could disrupt the impulse to think divergently that has been activated by schema-inconsistent stimuli. Indeed, we found that when PNS was low, schema-inconsistencies lead to better insight performance, and increased divergent thought, but did not increase overall fluency or convergent thought. When PNS was high, in contrast, inconsistencies decreased performance on insight problems and divergent thought, and did not influence fluency or convergent idea generation.

Since high PNS individuals prefer structure and convergent idea generation, a related issue is why there was no main effect of PNS on convergent thinking, not even in the schema-consistent condition. We note that that PNS only associates with increased convergent thought when personal fear of invalidity (PFI) is low (Rietzschel et al., 2007). Individuals high in PNS prefer structure, and prefer to generate ideas in a structured way, but structured information processing is easily disrupted, such as when individuals show a tendency to doubt and deliberate. We did not measure PFI here, and future research could explore the possibility that the current finding that schema inconsistency undermines divergent thinking and creative insight performance especially among individuals that are high in both PNS and PFI.

Theoretical contribution

The findings reported in this paper enhance our understanding of how schema-inconsistencies and PNS influence creativity. First, they address the apparent contradiction between social cognition research on the one hand, and creativity and diversity research on the other, with the former suggesting a decrease in cognitive functioning following schema-inconsistencies, and the latter suggesting an uplift in creative cognition. Although these two literatures seem to lead to different conclusions, our studies suggest that both research traditions are in fact right. We have shown, that schema inconsistencies can both increase, as well as decrease people's cognitive performance, and to get a better grasp of that dynamic we

need to consider individual differences. It would be good if future studies explored whether situationally induced need for structure (e.g., manipulated via time pressure) has the same effect.

Second, our study highlights the importance of a more fine-tuned understanding of the various processes that underlie performance. Specifically, in Study 2 we showed that uplifts and detriments to performance in the face of schema-inconsistencies are specific to divergent thought, but not ideational fluency or convergent thinking. This means that inconsistencies do not increase peoples' motivation or the speed with which people generate ideas (fluency), and that they do not make people think in a more careful, step-by step manner (convergent thinking). Instead, inconsistencies lead people to think 'out of the box' – consider many categories and switch between them rapidly – when PNS is low. Considering this process – divergent thinking – allows us to make predictions beyond creativity research. For instance, divergent thinking benefits creativity. However, one could also imagine that it would not be helpful, and could even be detrimental, on tasks that require a careful step-by-step approach, such as intelligence tasks that capitalize on analytical and deductive reasoning. It would be useful for future studies on the link between inconsistencies and cognitive performance to explore such fine-tuned process questions.

Lastly, our research extends past work on the role of PNS in creative endeavors. Specifically, from past research we know that people high in PNS are not that creative, unless they can achieve creativity via deeply exploring a narrow set of semantic categories. However, even this occurs under a limited set of circumstances. High PNS is associated with originality (via convergent thought) only when individuals are not concerned about getting things wrong (low PFI). In addition, several environmental variables can hinder their performance: people high in PNS are less motivated and less satisfied with their work in the absence of close monitoring and clear role definitions (Rietzschel, Slijkhuis & Van Yperen,

2013), and they tend to assume work strategies that are not conducive to achieving divergent thinking and creativity (Slijkhuis, 2012). Individuals low in PNS, on the other hand, display more creativity directly as a function of decreased structure in the environment: they are more creative and innovative given informational, rather than controlling performance feedback (Rietzschel, Slijkhuis, & Van Yperen, 2013; Slijkhuis, Rietzschel, & Van Yperen, 2013), and in the absence of close monitoring (Rietzschel et al, 2013). For these individuals the additional advantage is that they are not overly attached to rules and structure, allowing them for more freedom in divergent idea generation (Slijkhuis, 2012).

Extending those findings further, we have shown that in the presence of schemata-violation PNS is detrimental to divergent thinking and creativity, while in the presence of schema-confirming information PNS is unrelated to either of those measures (including convergent thought). This observation contributes to the PNS discussion in two important ways. First, it extends support for the notion that low PNS individuals have, in general, a harder time generating ideas: environmental variables that disrupt structure (i.e., the schema-inconsistent prime in our experiment) tend to undermine their divergent and creative performance, but environmental variables that provide structure (i.e., the schema-consistent prime) are not in themselves sufficient to elicit convergent thought. Second, it suggests that for optimal performance of both low and high PNS people, there needs to be a fit between individual differences and the environment. Environments that provide consistency, clarity, and predictability of roles, and that in addition decrease peoples' fear of invalidity, could be, according to what we currently know, optimal for individuals high PNS. Predictability and lowered fear of invalidity would allow such individuals to get at creative answers via convergent, persistent information processing (also see Dual Pathway to Creativity Model; De Dreu et al., 2008; Nijstad et al., 2010). Environments that provide autonomy and inspire non-schematic thinking, on the other hand, should be optimal for fostering divergent thought

and original ideas in individuals low in PNS. However a mismatch between people's levels of PNS, and the amount of structure in the environment, would likely disrupt the idea generation process, as we have observed in the case of high PNS individuals exposed to inconsistencies.

Practical Implications

On an applied level, our findings speak to researchers and practitioners interested in the different ways and conditions that foster superior creativity. As representatives of this field have uncovered, creativity can be fostered when peoples' beliefs about the laws of physics are challenged (Ritter et al., 2012), when individuals adapt new cultural norms (Leung & Chiu, 2010; Maddux, Adam, & Galinsky, 2010), or when they are compelled to embrace paradoxical (i.e., inconsistent) mental frames (Miron-Spektor et al., 2011; Wan & Chiu, 2002). Our findings suggest that such effects are contingent upon individual differences and that in people high in need for structure schema-inconsistencies may backfire, paradoxically, decreasing creativity. This conclusion is essential for practitioners trying to apply empirical findings to creativity training: inconsistency can inspire creativity, but only when individuals are ready to embrace it. Dealing with motivational concerns and environmental variables that may induce a need for structure (e.g., time pressure) is an essential first step in preparing ground for the violation of expectations.

A similar implication applies to diversity theories investigating challenging diversity – social diversity characterized by cross-cutting group membership (Crisp & Turner, 2011). This research stresses how one of the key aspects of modern diversity is that it is cross-cutting, i.e., it allows individuals to enter groups that they previously had no access to, leading to the erosion of diversity fault-lines. This research argued that exposure to such challenging diversity brings about not only decreased prejudice, but also generalized benefits in the form of more divergent, flexible and creative thought (Crisp & Turner, 2011; Gocłowska et al., 2013; Vasiljevic & Crisp, 2013). Our findings are in line with this idea, but

with the caveat that such benefits are contingent upon need for structure. This means that observations of individuals belonging to cross-cutting groups (e.g., a Moroccan professor, a female engineer) will promote superior creativity only when perceiver's need for structure is low, rather than high. This finding can raise awareness of the optimal conditions that need to be ensured before counter-stereotypes and schema-inconsistencies are introduced.

References

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, *45*(2), 357–376. doi:10.1037/0022-3514.45.2.357

Baas, M., De Dreu, C. K. W., & Nijstad, B. A. (2008). A meta-analysis of 25 years of mood-creativity research: Hedonic tone, activation, or regulatory focus? *Psychological Bulletin*, *134*(6), 779–806. doi:10.1037/a0012815 10.1037/a0012815

Baas, M., De Dreu, C. K. W., & Nijstad, B. A. (2012). Emotions that associate with uncertainty lead to structured ideation. *Emotion*, *12*(5), 1004–1014. doi:10.1037/a0027358

Bushman, B. J., Giancola, P. R., Parrott, D. J., & Roth, R. M. (2012). Failure to consider future consequences increases the effects of alcohol on aggression. *Journal of Experimental Social Psychology*, *48*(2), 591–595. doi:10.1016/j.jesp.2011.11.013

Crisp, R. J., & Turner, R. N. (2011). Cognitive adaptation to the experience of social and cultural diversity. *Psychological Bulletin*, *137*(2), 242–66. doi:10.1037/a0021840

De Dreu, C. K. W., Baas, M., & Nijstad, B. A. (2008). Hedonic tone and activation level in the mood-creativity link: toward a dual pathway to creativity model. *Journal of Personality and Social Psychology*, *94*(5), 739–56. doi:10.1037/0022-3514.94.5.739

De Dreu, C. K. W., Baas, M., Roskes, M., Sligte, D. J., Ebstein, R. P., Chew, S. H., … Shamay-Tsoory, S. G. (2013). Oxytonergic circuitry sustains and enables creative cognition in humans. *Social Cognitive and Affective Neuroscience*, 1–7. doi:10.1093/scan/nst094

De Dreu, C. K. W., Nijstad, B. A., & Baas, M. (2010). Behavioral activation links to creativity because of increased cognitive flexibility. *Social Psychological and Personality Science*, *2*(1), 72–80. doi:10.1177/1948550610381789

Dijksterhuis, A., & Meurs, T. (2006). Where creativity resides: The generative power of unconscious thought. *Consciousness and Cognition*, *15*(1), 135–146. doi:doi:10.1016/j.concog.2005.04.007

Förster, J., Friedman, R. S., Butterbach, E. B., & Sassenberg, K. (2005). Automatic effects of deviancy cues on creative cognition. *European Journal of Social Psychology*, *35*(3), 345–359. doi:10.1002/ejsp.253

Gocłowska, M. A., & Crisp, R. J. (2013). On counter-stereotypes and creative cognition: When interventions for reducing prejudice can boost divergent thinking. *Thinking Skills and Creativity*, *8*, 72–79. doi:10.1016/j.tsc.2012.07.001

Gocłowska, M. A., Crisp, R. J., & Labuschagne, K. (2013). Can counter-stereotypes boost flexible thinking? *Group Processes & Intergroup Relations*, *16*(2), 217–231. doi:10.1177/1368430212445076

Harkins, S. G. (2006). Mere effort as the mediator of the evaluation-performance relationship. *Journal of Personality and Social Psychology*, *91*(3), 436–55. doi:10.1037/0022-3514.91.3.436

Hayes, A. F. (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis*. New York & London: The Guilford Press.

Hutter, R. R. C., & Crisp, R. J. (2005). The composition of category conjunctions. *Personality and Social Psychology Bulletin*, *31*(5), 647–657. doi:10.1177/0146167204271575

Kounios, J., Frymiare, J. L., Bowden, E. M., Fleck, J. I., Subramaniam, K., Parrish, T. B., & Jung-Beeman, M. (2006). Subsequent solution by sudden insight. *Psychological Science*, *17*(10), 882–890.

Kruglanski, A. W., & Shteynberg, G. (2012). Cognitive consistency as means to an end. How subjective logic affords knowledge. In B. Gawronski & F. Strack (Eds.), *Cognitive consistency: A unifying concept in social psychology* (pp. 245–264). New York: Guilford Press.

Leicht, C., Crisp, R. J., & Randsley de Moura, G. (2013). Need for structure predicts leadership preference. *Group Dynamics: Theory, Research, and Practice*, *17*(1), 53–66. doi:10.1037/a0031476

Leung, A. K.-Y., & Chiu, C.-Y.-Y. (2010). Multicultural experience, idea receptiveness, and creativity. *Journal of Cross-Cultural Psychology*, *41*(5-6), 723–741. doi:10.1177/0022022110361707

Maddux, W. W., Adam, H., & Galinsky, A. D. (2010). When in Rome ... Learn why the Romans do what they do: how multicultural learning experiences facilitate creativity. *Personality & Social Psychology Bulletin*, *36*(6), 731–41. doi:10.1177/0146167210367786

Marsh, R. L., Ward, T. B., & Landau, J. D. (1999). The inadvertent use of prior knowledge in a generative cognitive task. *Memory & Cognition*, *27*(1), 94–105.

Mayer, J. D., & Gaschke, Y. N. (1988). The experience and meta-experience of mood. *Journal of Personality and Social Psychology*, *55*(1), 102–111. doi:10.1037/0022-3514.55.1.102

Mendes, W. B., Blascovich, J., Hunter, S. B., Lickel, B., & Jost, J. T. (2007). Threatened by the unexpected: physiological responses during social interactions with expectancy-violating partners. *Journal of Personality and Social Psychology*, *92*(4), 698–716. doi:10.1037/0022-3514.92.4.698

Miron-Spektor, E., Gino, F., & Argote, L. (2011). Paradoxical frames and creative sparks: Enhancing individual creativity through conflict and integration. *Organizational Behavior and Human Decision Processes*, *116*(2), 229–240. doi:10.1016/j.obhdp.2011.03.006

Neuberg, S. L., & Newsom, J. T. (1993). Personal need for structure: Individual differences in the desire for simpler structure. *Journal of Personality and Social Psychology*, *65*(1), 113–131. doi:10.1037/0022-3514.65.1.113

Nijstad, B. A., De Dreu, C. K. W., & Rietzschel, E. F. (2010). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology*, *21*(1), 37–41.

Oppenheimer, D. M., Meyvis, T., & Davidenko, N. (2009). Instructional manipulation checks: Detecting satisficing to increase statistical power. *Journal of Experimental Social Psychology*, *45*(4), 867–872. doi:10.1016/j.jesp.2009.03.009

Porath, C. L., & Erez, A. (2009). Overlooked but not untouched: How rudeness reduces onlookers' performance on routine and creative tasks. *Organizational Behavior and Human Decision Processes*, *109*(1), 29–44. doi:10.1016/j.obhdp.2009.01.003

Reiter-Palmon, R., Mumford, M. D., O'Connor Boes, J., & Runco, M. A. (1997). Problem construction and creativity: The role of ability, cue consistency, and active processing. *Creativity Research Journal*, *10*(1), 9–23.

Rietzschel, E. F., De Dreu, C. K. W., & Nijstad, B. A. (2007). Personal need for structure and creative performance: The moderating influence of fear of invalidity. *Personality and Social Psychology Bulletin*, *33*(6), 855–866. doi:10.1177/0146167207301017

Rietzschel, E. F., Slijkhuis, J. M., & Van Yperen, N. W. (2013). Close monitoring as a contextual stimulator: How need for structure affects the relation between close monitoring and work outcomes. *European Journal of Work and Organizational Psychology*, (June 2013), 1–11. doi:10.1080/1359432X.2012.752897

Ritter, S. M., Damian, R. I., Simonton, D. K., Van Baaren, R. B., Strick, M., Derks, J., & Dijksterhuis, A. (2012). Diversifying experiences enhance cognitive flexibility. *Journal of Experimental Social Psychology*, *48*(4), 961–964. doi:10.1016/j.jesp.2012.02.009

Roese, N. J., & Sherman, J. W. (2007). Expectancy. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 91–115). New York: Guilford Press.

Rubin, M., Paolini, S., & Crisp, R. J. (2013). Linguistic Description Moderates the Evaluations of Counterstereotypical People. *Social Psychology*, *44*(4), 289–298. doi:10.1027/1864-9335/a000114

Sassenberg, K., & Moskowitz, G. B. (2005). Don't stereotype, think different! Overcoming automatic stereotype activation by mindset priming. *Journal of Experimental Social Psychology*, *41*(5), 506–514. doi:10.1016/j.jesp.2004.10.002

Schaller, M., Boyd, C., Yohannes, J., & O'Brien, M. (1995). The prejudiced personality revisited: Personal need for structure and formation of erroneous group stereotypes. *Journal of Personality and Social Psychology*, *68*(3), 544–555. doi:10.1037//0022-3514.68.3.544

Slijkhuis, J. M. (2012). *A Structured Approach to Need for Structure at Work*. PhD Dissertation. Rijksuniversiteit Groeningen. Retrieved from http://dissertations.ub.rug.nl/faculties/gmw/2012/m.slijkhuis/

Slijkhuis, J. M., Rietzschel, E. F., & Van Yperen, N. W. (2013). How evaluation and need for structure affect motivation and creativity. *European Journal of Work and Organizational Psychology*, *22*(1), 15–25. doi:10.1080/1359432X.2011.626244

Sternberg, R. J., & Lubart, T. I. (2002). *Defying the Crowd. Cultivating Creativity in a Culture of Conformity*. Free Press.

Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management Journal*, *45*(6), 1137–1148. doi:10.2307/3069429

Vasiljevic, M., & Crisp, R. J. (2013). Tolerance by surprise: Evidence for a generalized reduction in prejudice and increased egalitarianism through novel category combination. *PLOS One*, *8*(3). doi:10.1371/journal.pone.0057106

Wan, W. W. N., & Chiu, C.-Y. (2002). Effects of Novel Conceptual Combination on Creativity. *The Journal of Creative Behavior*, *36*(4), 227–240. doi:10.1002/j.2162-6057.2002.tb01066.x

Footnotes

[1] Online participants tend to pay less attention to experimental materials, and can sometimes search the Internet to find answers (Oppenheimer, Meyvis, & Davidenko, 2009). To eliminate such bias, we dropped participants who took extremely short (8, 10, 12 & 13 min.) and extremely long (63, 74, 78, and 441 min.) to complete the questionnaire (time M = 30.71, SD = 14.13). Inspecting the data case by case revealed that participants with extremely short responses entered nonsense words on the creativity task, and continuously pressed the same button on personality questionnaires. Including these participants, the interaction term on creative insight was significant: (B = -1.06, t = -2.04, p = .046).

[2] This technique has considerable benefit over traditional pick-a-point approaches (e.g., probing the interaction at +/- 1SD from M, or the 10th, 50th, and 90th percentile), because it removes the need for arbitrary decisions on what constitutes "low", "medium" and "high" levels of the moderator. Instead, this method can indicate the exact point on the continuum of the moderator at which the relationship between the dependent and independent variable becomes significant. Because of this precision in establishing when given effects occur, the technique is increasingly popular (e.g., Bushman, Giancola, Parrott, & Roth, 2012).

[3] When we inserted the four mood states as covariates, the interaction term remained significant (B = -1.39, t = -2.62, p = .012). The relationship between PNS and creativity remained significant in the inconsistent (B = -2.21, t = -2.43, p = .019), and remained not significant in the consistent condition (B = 0.58, t = 0.96, p = .341). The direction of slopes remained the same, and the cutoff values almost identical (upper cutoff = 5.29, equivalent to 1.25 SD above M, B = -1.55, t = -2.01, p = .050; lower cutoff = 3.24, equivalent to 0.97 SD below M, B = 1.32, t = 2.01, p = .050).

[4] Words presented alongside the pictures were approach or avoidance related (a manipulation orthogonal to the inconsistency manipulation). This had no effects on relevant

manipulation checks, and did not influence flexibility, *F*s (1,77) between .06 - 1.67, all *p*s > .20). Although not further discussed, it is of note that including this manipulation in our regression models did not alter the significance of the focal results.

[5] Because of univariate outliers and a positively skewed distribution, repetitions, divergent, and convergent items (but not switches) were first winsorized and, when this did not improve the distribution, square root transformed (Tabachnick & Fidell, 2007, pp. 60–116). The interaction terms reported here are significant regardless of this transformation.

[6] When we inserted the four mood states as covariates, the interaction term was still significant (*B* = -.48, *t* = -2.99, *p* = .004). The relationship between PNS and creativity remained significant in the inconsistent (*B* = -0.56, *t* = -2.26, *p* = .027), and remained not significant in the consistent condition (*B* = 0.40, *t* = 1.88, *p* = .064). Using the Johnson-Neyman regions of significance estimate, the direction of slopes remained the same and the cutoff values almost identical (upper cutoff = 4.48, equivalent to 1.30 *SD* above *M*, *B* = -0.45, *t* = -1.99, *p* = .050; lower cutoff = 2.91, equivalent to 0.53 *SD* below *M*, *B* = 0.31, *t* = 1.99, *p* = .050).

[7] When we inserted the four mood states as covariates, the interaction term was still significant (*B* = -1.98, *t* = -2.92, *p* = .005), and the relationship between PNS and creativity remained significant in the inconsistent (*B* = -0.56, *t* = -2.26, *p* = .019), and remained not significant in the consistent condition (*B* = 1.80, *t* = 1.99, *p* = .051). The Johnson-Neyman regions of significance estimate revealed slopes in the same direction, and with almost identical cutoff values (upper cutoff = 4.20, equivalent to 0.97 *SD* above *M*, *B* = -1.63, *t* = -1.99, *p* = .050; lower cutoff = 2.61, equivalent to 0.87 *SD* below *M*, *B* = 1.51, *t* = 1.99, *p* = .050).